

Analysis of European Modular Cultivation System (EMCS) Operations

In an effort to correlate EMCS operations with SAMS vibratory measurements, several analyses were performed. These were based on SAMS acceleration data measured in the Columbus module during EMCS operation times. The first analysis was a cursory pass to examine SAMS daily roadmap spectrograms to check for distinct transitions. Next, rotor frequency information gleaned from an EMCS web page was leveraged along with a tailored routine to seek correlation between expected EMCS ops and possible spectral signatures in SAMS measurements. Last, ancillary telemetry data possibly related to EMCS operations was queried and compared to 5-minute interval RMS data computed from SAMS measurements.

First, the results from a preliminary analysis of SAMS acceleration data for the last week of April 2014 through the first 3 days of May 2014 showed several distinct transitions like that seen in the black rectangle on the first page of this document. However, nothing conclusively could be identified specific to or associated with EMCS equipment.

Next, an email received from the Operations Controller gave recent GMT time spans when EMCS payload equipment was known to start/stop and when their science runs started/stopped. Results from an analysis that followed from that email led to frequency information with potential for detection of EMCS rotor signature. It was thought that if energetic enough, that might show up as a narrow-band peak in the low-frequency range from about 0.03 Hz to about 1.4 Hz. In order to best focus on this range, a tailored spectral analysis routine was implemented to hone in. The results obtained perhaps match some part of the frequency information, but do not match what was given for expected GMT time spans.

Last, ancillary data for EXPRESS Rack 3 (ER3) and for EMCS were queried from the telemetry database. This query was submitted in the form of a NRT List Request in the Enhanced HOSC System (EHS). The results of that request provided specific GMT transition times with 10-minute resolution. This gave times to cross-check with changes in SAMS acceleration data, not just for the expected rotor frequency range, but across the entire SAMS sensor measurement spectrum. Ultimately, this led to a comprehensive analysis run to gather 5-minute interval RMS SAMS data from GMT 05-May-2014/00:00 to GMT 08-May-2014/00:00, which included the transition times from the NRT List Request for potential correlation. Those results did not show definitive correlation between transition times that were thought perhaps due to EMCS operations.

The plots and narrative on the next few pages reflect some of the details discussed above.



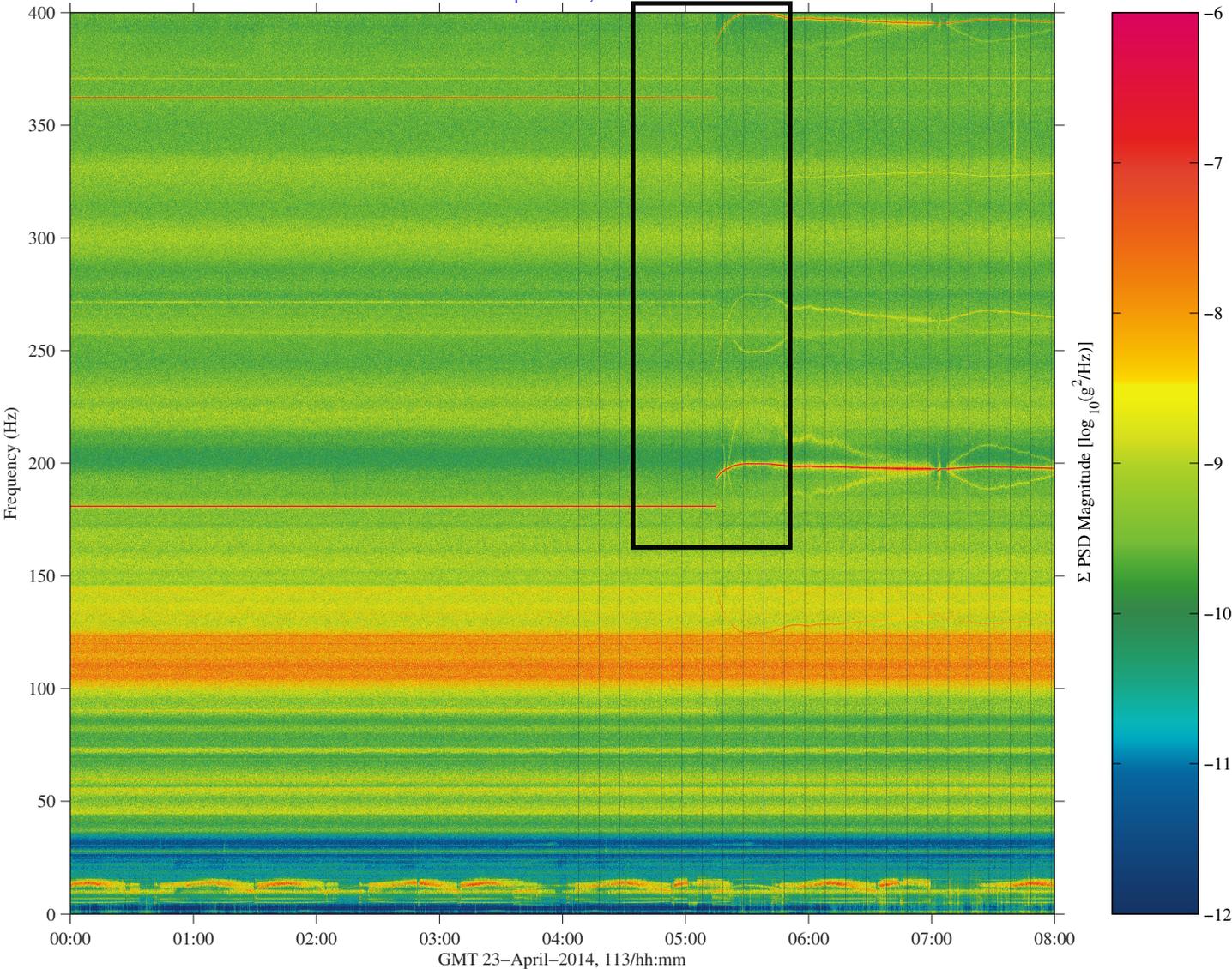
EMCS Ops Qualify

sams2, 121f08 at COL1A1, ER3, Seat Track near D1:[371.17 193.43 165.75]
 1000.0000 sa/sec (400.00 Hz)
 $\Delta f = 0.122$ Hz, Nfft = 8192
 Temp. Res. = 8.192 sec, No = 0

sams2, 121f08

Start GMT 23-April-2014, 113/00:00:00.001

Sum
 Hanning, k = 3515
 Span = 8.00 hours



from: /misc/yoda/pub/pad_pims_25-Apr-2014.07:47:42.242

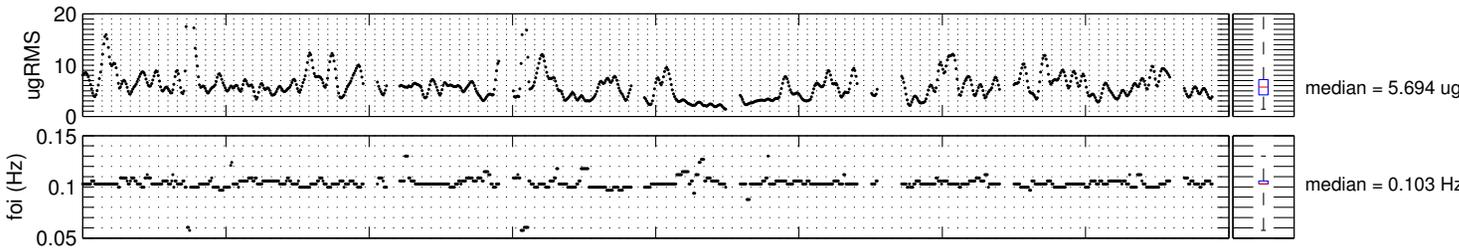
Description	
Sensor	SAMS 121f08 1000.0 sa/sec, 400.0 Hz
Location	COL1A1, ER3, Seat Track near D1
Plot Type	Spectrogram

- Notes:**
- This 8-hour spectrogram shows a distinct transition at about GMT 23-April-2014, 05:15.
 - The transition outlined in the black rectangle is obvious just under 200 Hz and just under 400 Hz.
 - Other transitions similar to the one seen here show up during the span of EMCS ops reported by the Operations Controller (OC).

Regime:	Vibratory
Category:	Columbus
Source:	EMCS Ops

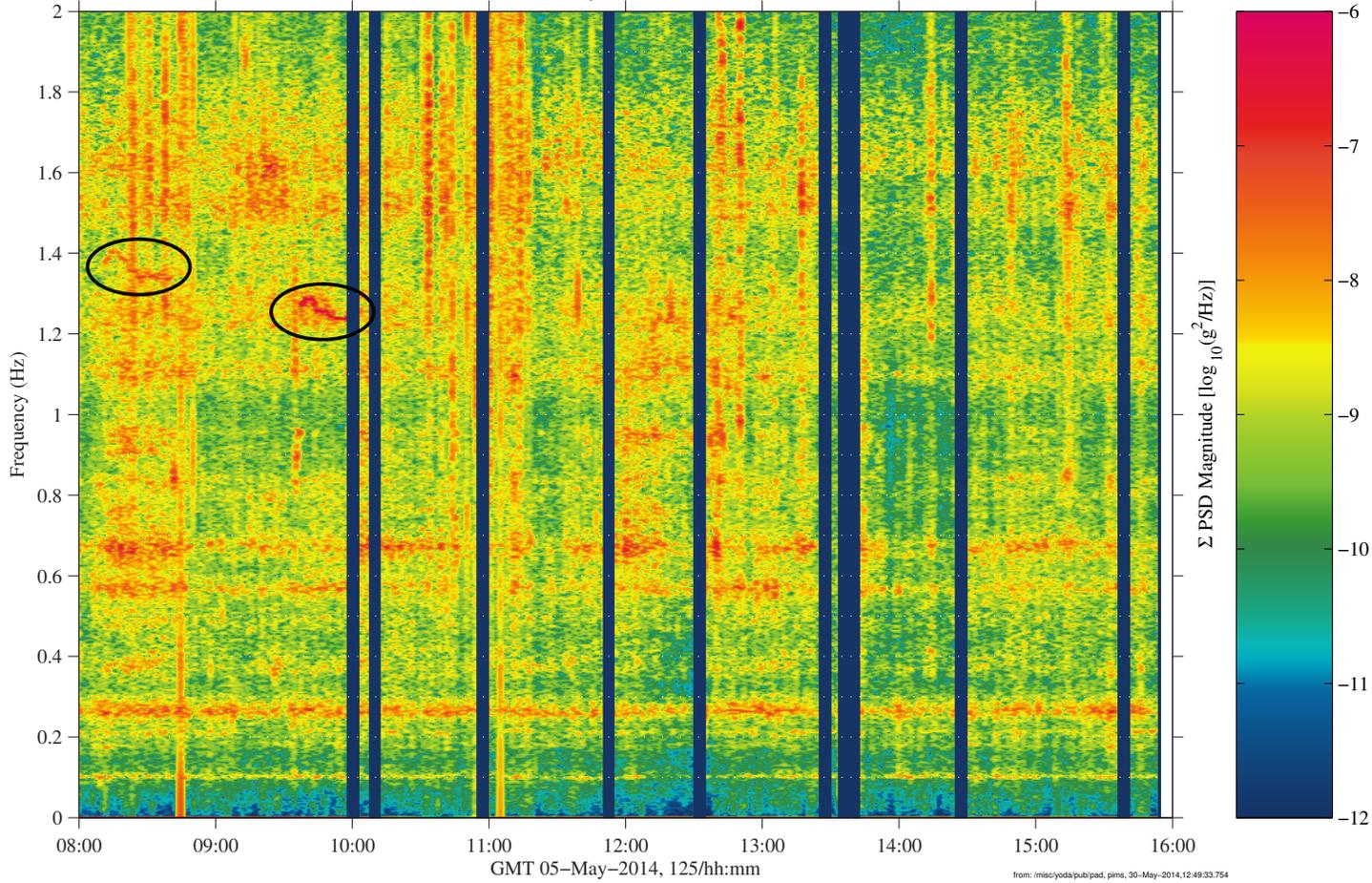


EMCS Ops Qualify



sams2, 121f08006 at COL1A1, ER3, Seat Track near D1:[371.17 193.43 165.75]
 198.0000 sa/sec (6.00 Hz)
 $\Delta f = 0.003$ Hz, Nfft = 65536
 Temp. Res. = 27.960 sec, No = 60000
 sams2, 121f08006
 Start GMT 05-May-2014, 125/08:00:00.005

Sum
 Hanning, k = 1019
 Span = 7.91 hours



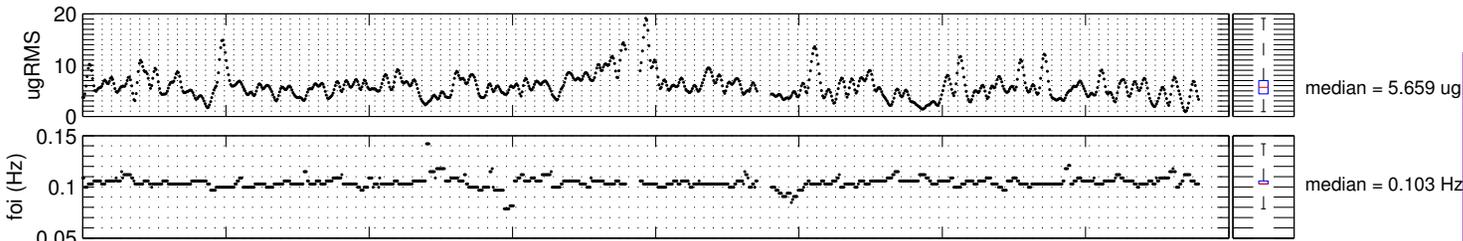
Description	
Sensor	SAMS 121f08006 198.00 sa/sec, 6.00 Hz
Location	COL1A1, ER3, Seat Track near D1
Plot Type	Spectrogram

- Notes:**
- This tailored 8-hour spectrogram shows what appears to be 2 start-up signatures: (1) one just after GMT 05-May-2014, 08:00, and (2) the other at about 09:40 or so.
 - The two start-up signatures are outlined in black ovals near 1.3 Hz and 1.4 Hz.
 - The two GMT start-up times do not match the time given as expected for the EMCS operations start time on this day, which was 11:30.
 - These measurements made by SAMS in the Columbus module do not clearly show distinctive or discernible startup-up signature(s) at the given GMT of 11:30.

Regime:	Vibratory
Category:	Columbus
Source:	EMCS Ops



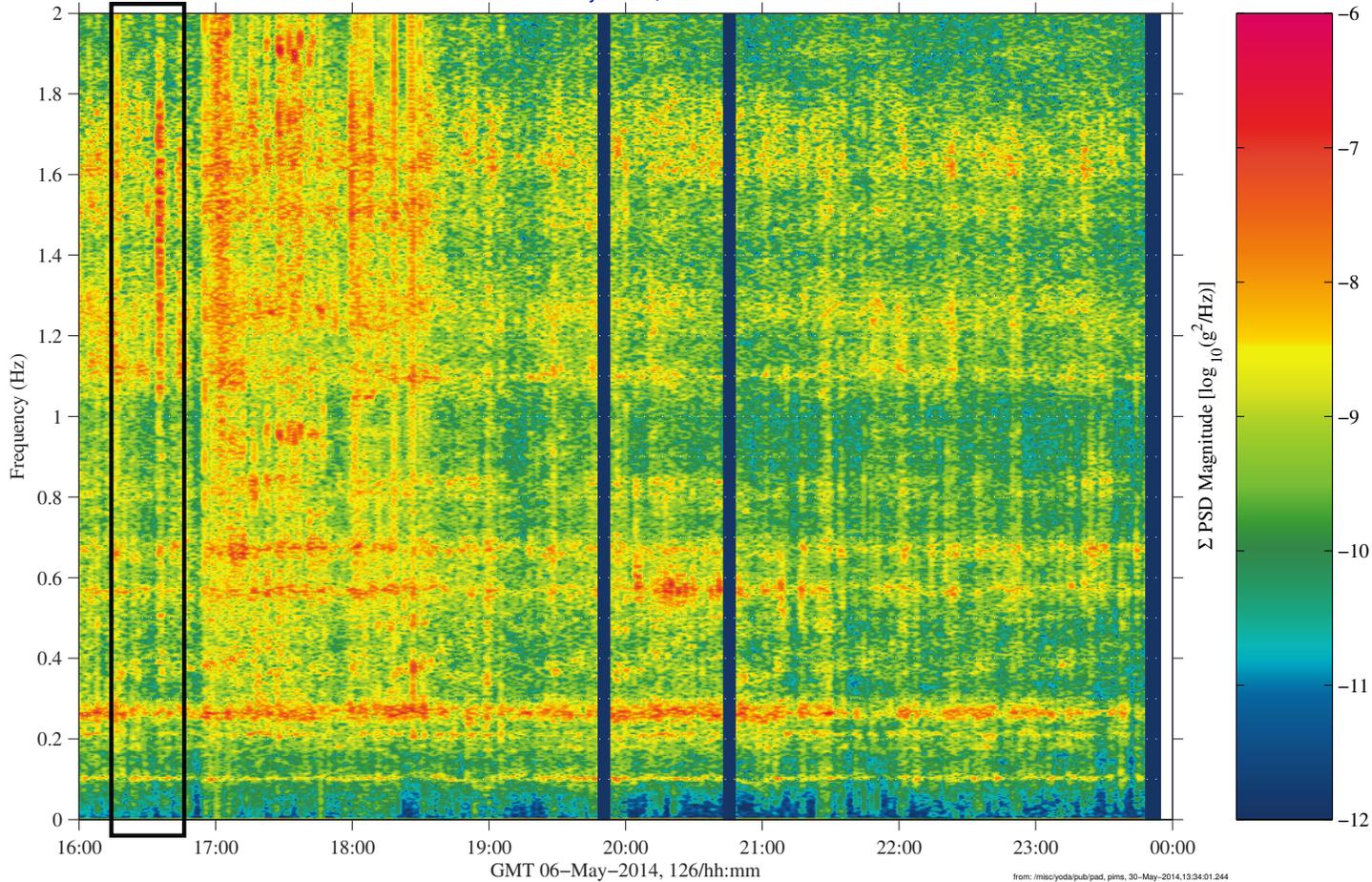
EMCS Ops Qualify



sams2, 121f08006 at COL1A1, ER3, Seat Track near D1:[371.17 193.43 165.75]
 198.0000 sa/sec (6.00 Hz)
 $\Delta f = 0.003$ Hz, Nfft = 65536
 Temp. Res. = 27.960 sec, No = 60000
 sams2, 121f08006
 Start GMT 06-May-2014, 126/16:00:00.002

Sum
 Hanning, k = 1019
 Span = 7.91 hours

Description	
Sensor	SAMS 121f08006 198.00 sa/sec, 6.00 Hz
Location	COL1A1, ER3, Seat Track near D1
Plot Type	Spectrogram

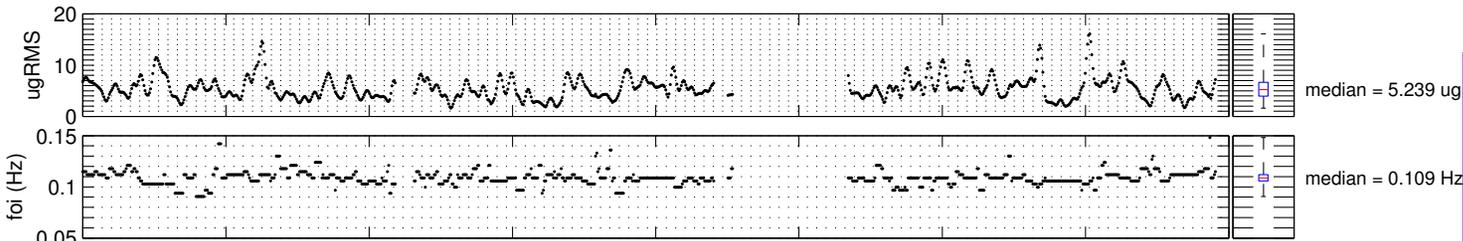


- Notes:**
- This tailored 8-hour spectrogram was aimed at detecting shutdown or turn-off spectral signature expected for EMCS ops at 16:30.
 - The black rectangle between 16:00 and 17:00 serves as focal area for detection of any such deactivation signature.
 - Nothing discernible turns off at the expected GMT given for EMCS ops at 16:30.

Regime:	Vibratory
Category:	Columbus
Source:	EMCS Ops



EMCS Ops Qualify

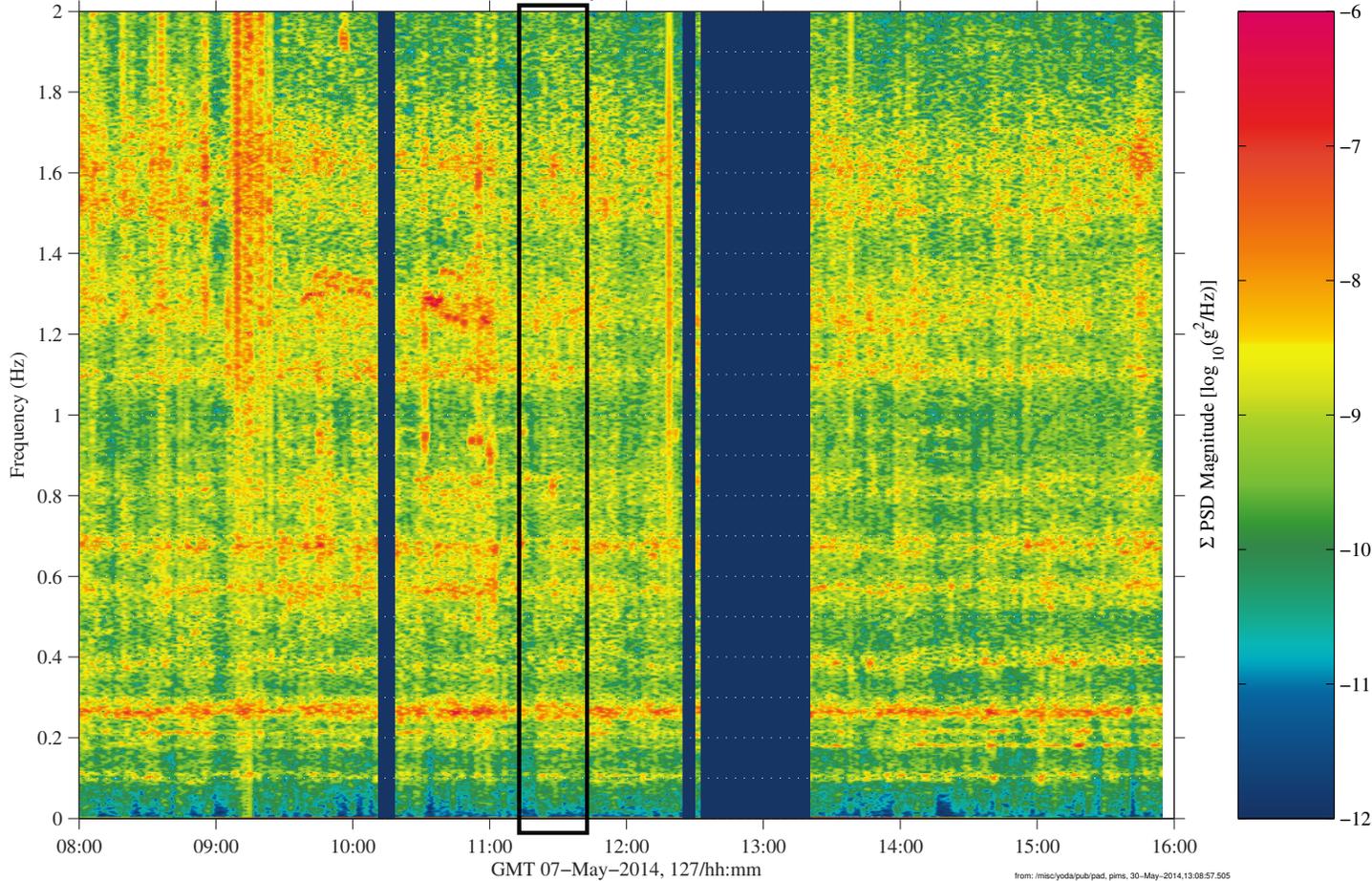


sams2, 121f08006 at COL1A1, ER3, Seat Track near D1:[371.17 193.43 165.75]
 198.0000 sa/sec (6.00 Hz)
 $\Delta f = 0.003$ Hz, Nfft = 65536
 Temp. Res. = 27.960 sec, No = 60000
 sams2, 121f08006
 Start GMT 07-May-2014, 127/08:00:00.002

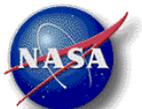
Sum
 Hanning, k = 1019
 Span = 7.91 hours

Description	
Sensor	SAMS 121f08006 198.00 sa/sec, 6.00 Hz
Location	COL1A1, ER3, Seat Track near D1
Plot Type	Spectrogram

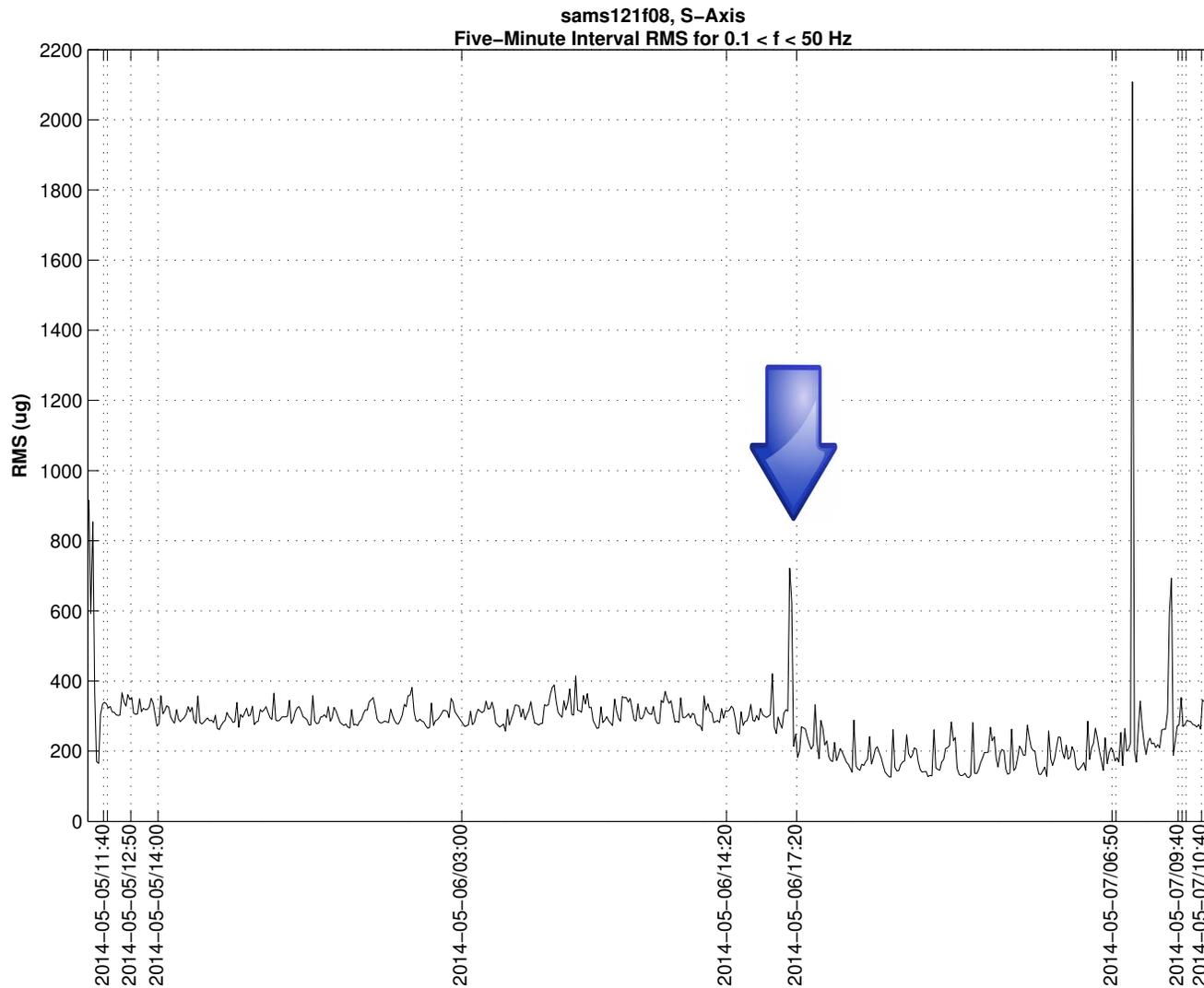
- Notes:**
- This tailored 8-hour spectrogram has a black rectangle roughly centered on the expected start-up (a 2nd start-up) of EMCS ops at GMT 11:15.
 - Nothing clearly starts in this window of time.



Regime:	Vibratory
Category:	Columbus
Source:	EMCS Ops



EMCS Ops Quantify



Description

Sensor	SAMS 121f08 1000.0 sa/sec, 400.0 Hz
Location	COL1A1, ER3, Seat Track near D1
Plot Type	RMS vs. Time

Notes:

- This 5-minute interval RMS plot shows an interesting transition at about GMT 06-May-2014, 17:20 as marked by the blue arrow.
- Notice how the RMS value transitions from a steady-state value to a slow, downward evolution after the 17:20 transition time.
- This does give some nebulous correlation between a transition in the microgravity vibratory environment between 0.1 and 50 Hz with a transition time observed from ancillary telemetry data. Very many telemetry items for both EXPRESS Rack 3 and EMCS ops turned off all together at this time, so nothing specific could be identified.

Regime:	Vibratory
Category:	Columbus
Source:	EMCS Ops

